WHAT IS CLAIMED IS:

1. A drive device for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends, comprising:

a piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, said piezoelectric transformer converting a primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output in a second phase opposite the first phase from the second secondary electrode, and enabling connection of the electrical terminals at both ends of the cold cathode fluorescent lamp between the first secondary electrode and the second secondary electrode;

a drive arrangement for applying the primary ac input to the primary electrodes; and

a brightness control circuit for controlling cold cathode fluorescent lamp brightness by detecting a phase difference between the secondary ac output and primary ac input such that,

when the detected phase difference is greater than a specified phase difference, the drive arrangement reduces the input power to the primary electrodes of the piezoelectric transformer to reduce the lamp brightness, and

when the detected phase difference is less than a specified phase difference, the drive arrangement increases the input power to the primary electrodes of the piezoelectric transformer to increase the

lamp brightness.

2. A cold cathode fluorescent lamp drive device according to claim 1, further comprising:

a variable oscillation circuit for oscillating the primary ac input at a specified frequency;

a startup control circuit for controlling the frequency of the primary ac input from the variable oscillation circuit to strike the cold cathode fluorescent lamp; and

startup detector for detecting cold cathode fluorescent lamp startup.

3. A cold cathode fluorescent lamp drive device according to claim 2, wherein the startup control circuit controls the variable oscillation circuit to sweep the primary ac input from a specified frequency to a frequency below said frequency to strike the cold cathode fluorescent lamp, and

controls the variable oscillation circuit to fix and oscillate at the frequency at which the startup detector detects cold cathode fluorescent lamp startup.

4. A cold cathode fluorescent lamp drive device according to claim 2, wherein the brightness control circuit stops operating when striking the cold cathode fluorescent lamp.

5. A cold cathode fluorescent lamp drive device according to claim 2, wherein the frequency of the primary ac input is a frequency other than a frequency at which the secondary side of the piezoelectric transformer shorts, and a frequency intermediate to the frequency at which the piezoelectric transformer secondary side shorts and the secondary side

opens.

6. A cold cathode fluorescent lamp drive device according to claim 2, wherein the primary ac input frequency is a frequency other than a frequency in the band ±0.3 kHz of the piezoelectric transformer resonance frequency when the secondary side shorts, and a frequency other than a frequency in the band ±0.3 kHz of the frequency intermediate to the resonance frequency of the piezoelectric transformer when the secondary side shorts and the resonance frequency when the secondary side is open.

7. A cold cathode fluorescent lamp drive device according to claim 2, wherein the frequency of the primary ac input is higher than the frequency of the maximum step-up ratio of the piezoelectric transformer producing the lowest cold cathode fluorescent lamp load.

8. A cold cathode fluorescent lamp drive device according to claim 1, further comprising an inductor connected in series with one primary electrode, forming a resonance circuit with the piezoelectric transformer;

wherein the drive arrangement comprises

a dc power source,

a drive control circuit for outputting a drive control signal based on the primary ac input frequency, and

a drive circuit connected to the dc power source and both sides of the resonance circuit for amplifying the drive control signal to a voltage level required to drive the piezoelectric transformer, outputting the ac input signal to the resonance circuit, and inputting the ac voltage to the primary electrodes; and

the brightness control circuit comprises

a voltage detector circuit for detecting the ac voltage of the secondary ac output from at least one of the first and second secondary electrodes, and outputting an ac detection signal,

a phase difference detector circuit for detecting a phase difference between the ac input signal and detected ac signal, and outputting a dc voltage according to the detected phase difference,

a phase control circuit for controlling the phase of the drive control signal, and

a comparison circuit for comparing the dc voltage and a reference voltage, and controlling the phase control circuit so that the dc voltage and reference voltage match.

9. A cold cathode fluorescent lamp drive device according to claim 8, wherein the ac input signal frequency is near the resonance frequency of the resonance circuit.

10. A cold cathode fluorescent lamp drive device according to claim 8, wherein the voltage detector circuit comprises:

a level shifter for shifting the ac voltage of the secondary ac output to a specific voltage amplitude level; and

a zero cross detection circuit for switching and outputting the ac detection signal when the level shifter output signal crosses zero.

11. A cold cathode fluorescent lamp drive device according to claim 8, wherein the phase detector circuit comprises:

a logical AND for taking the AND of the ac input signal and ac detection signal, and outputting a phase difference signal; and

an averaging circuit for averaging the phase difference signal

and outputting a dc voltage.

12. A cold cathode fluorescent lamp drive device according to claim 8, wherein the drive circuit comprises:

a first series connection having a first switching element and a second switching element connected in series;

a second series connection parallel connected to the first series connection and having a third switching element and a fourth switching element connected in series;

a first element drive circuit connected to the first switching element for driving the first switching element;

a second element drive circuit connected to the second switching element for driving the second switching element;

a third element drive circuit connected to the third switching element for driving the third switching element; and

a fourth element drive circuit connected to the fourth switching element for driving the fourth switching element.

13. A cold cathode fluorescent lamp drive device according to claim 12, wherein the resonance circuit is connected between the node between the first switching element and second switching element, and the node between the third switching element and fourth switching element.

14. A cold cathode fluorescent lamp drive device according to claim 13, wherein the drive control signal comprises:

a first element control signal for driving the first element drive circuit;

a second element control signal for driving the second element

drive circuit;

a third element control signal for driving the third element drive circuit; and

a fourth element control signal for driving the fourth element drive circuit.

15. A cold cathode fluorescent lamp drive device according to claim 14, wherein the first element control signal and second element control signal are controlled by the drive control circuit so that the first switching element and second switching element switch alternately on and off at a specific on time ratio; and

the third element control signal and fourth element control signal are controlled by the drive control circuit so that the third switching element and fourth switching element switch alternately on and off at the same frequency and on time ratio as the first element control signal and second element control signal.

16. A cold cathode fluorescent lamp drive device according to claim 14, wherein the first element control signal, second element control signal, third element control signal, or fourth element control signal is used in place of the ac input signal for phase difference signal detection.

17. A cold cathode fluorescent lamp drive device according to claim 15, wherein the ac input signal is a combined rectangular signal combining the first element control signal, second element control signal, third element control signal, and fourth element control signal.

18. A drive device for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends,

comprising:

a piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, said piezoelectric transformer converting a primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output of a second phase opposite the first phase from the second secondary electrode, and enabling connection of the electrical terminals at both ends of the cold cathode fluorescent lamp between the first secondary electrode and the second secondary electrode;

a variable oscillation circuit for oscillating the primary ac input at a specified frequency;

a drive arrangement for applying the primary ac input to the primary electrodes; and

a brightness control circuit for controlling cold cathode fluorescent lamp brightness by detecting an ac voltage of the secondary ac output applied to the end electrical terminals of the cold cathode fluorescent lamp such that,

when the detected ac voltage of the secondary ac output is greater than a specific voltage, the primary ac input frequency approaches the resonance frequency of the piezoelectric transformer by the variable oscillation circuit, and

when the detected ac voltage of the secondary ac output is less than the specific voltage, the primary ac input frequency recedes from the resonance frequency of the piezoelectric transformer by the variable

oscillation circuit.

19. A drive device for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends, comprising:

a piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, said piezoelectric transformer converting a primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output of a second phase opposite the first phase from the second secondary electrode, and enabling connection of the electrical terminals at both ends of the cold cathode fluorescent lamp between the first secondary electrode and the second secondary electrode;

a drive arrangement for applying the primary ac input to the primary electrodes; and

a brightness control circuit for controlling cold cathode fluorescent lamp brightness by detecting an ac voltage of the secondary ac output such that,

when the detected ac voltage of the secondary ac output is greater than a specific voltage, the drive arrangement reduces the ac voltage of the primary ac input to reduce the lamp brightness, and

when the detected ac voltage of the secondary ac output is less than a specific voltage, the drive arrangement increases the ac voltage of the primary ac input to increase the lamp brightness.

20. A cold cathode fluorescent lamp device comprising:

a cold cathode fluorescent lamp drive device according to claim 1; and

one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends connected between one and another of first and second secondary electrodes of the piezoelectric transformer.

21. A drive method for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends, comprising:

applying a primary ac input from a drive arrangement to primary electrodes of a piezoelectric transformer,

the piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, converting the primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output in a second phase opposite the first phase from the second secondary electrode;

striking the cold cathode fluorescent lamp connected with both end electrical terminals thereof connected between the first and the second secondary electrodes by applying the first phase secondary ac output to one of the electrical terminals, and applying the second phase second ac output to the other electrical terminal;

detecting a phase difference between the secondary ac output and primary ac input by means of a brightness control circuit for controlling cold cathode fluorescent lamp brightness;

controlling the drive arrangement to reduce primary ac input power to the primary electrodes of the piezoelectric transformer when the detected phase difference is greater than a specified phase difference; and

controlling the drive arrangement to increase primary ac input power to the primary electrodes of the piezoelectric transformer when the detected phase difference is less than a specified phase difference.

22. A cold cathode fluorescent lamp drive method according to claim 21, whereby a variable oscillation circuit for oscillating the primary ac input is controlled to sweep the primary ac input from a specified frequency to a frequency below said frequency to strike the cold cathode fluorescent lamp, and

is controlled to fix and oscillate at the frequency at which cold cathode fluorescent lamp startup is detected.

23. A cold cathode fluorescent lamp drive method according to claim 21, wherein the frequency of the primary ac input is a frequency other than a frequency at which the secondary side of the piezoelectric transformer shorts, and a frequency intermediate to the frequency at which the piezoelectric transformer secondary side shorts and the secondary side opens.

24. A cold cathode fluorescent lamp drive method according to claim 21, wherein the primary ac input frequency is a frequency other than a frequency in the band ±0.3 kHz of the piezoelectric transformer resonance frequency when the secondary side shorts, and a frequency other than a frequency in the band ±0.3 kHz of the frequency intermediate to the resonance frequency of the piezoelectric transformer when the secondary

side shorts and the resonance frequency when the secondary side is open.

25. A cold cathode fluorescent lamp drive method according to claim 21, wherein the frequency of the primary ac input is higher than the frequency of the maximum step-up ratio of the piezoelectric transformer producing the lowest cold cathode fluorescent lamp load.

26. A drive method for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends, comprising:

applying a primary ac input oscillated by a variable oscillation circuit from a drive arrangement to primary electrodes of a piezoelectric transformer,

the piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, the piezoelectric transformer converting the primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output in a second phase opposite the first phase from the second secondary electrode;

striking the cold cathode fluorescent lamp connected with both end electrical terminals thereof connected between the first and second secondary electrodes by applying the first phase secondary ac output to one of the electrical terminals, and applying the second phase second ac output to the other electrical terminal;

detecting an ac voltage of the secondary ac output applied to the end electrical terminals of the cold cathode fluorescent lamp by means of

a brightness control circuit for controlling cold cathode fluorescent lamp brightness;

controlling the drive arrangement to reduce the ac voltage of the primary ac input when the detected ac voltage of the secondary ac output is greater than a specified voltage;

controlling the drive arrangement to increase the ac voltage of the primary ac input when the detected ac voltage of the secondary ac output is less than a specified voltage; and

making the detected ac voltage of the secondary ac output equal to the specified voltage.

27. A drive method for one or a plurality of series-connected cold cathode fluorescent lamps having an electrical terminal at both ends, comprising:

applying a primary ac input oscillated by a variable oscillation circuit from a drive arrangement to primary electrodes of a piezoelectric transformer,

the piezoelectric transformer having a pair of primary electrodes and first and second secondary electrodes, converting the primary ac input from the primary electrodes by a piezoelectric effect to a secondary ac output, outputting a secondary output in a first phase from the first secondary electrode and outputting a secondary output in a second phase opposite the first phase from the second secondary electrode;

striking the cold cathode fluorescent lamp connected with both end electrical terminals thereof connected between the first and the second secondary electrodes by applying the first phase secondary ac output to one

of the electrical terminals, and applying the second phase second ac output to the other electrical terminal;

detecting an ac voltage of the secondary ac output applied to the end electrical terminals of the cold cathode fluorescent lamp by means of a brightness control circuit for controlling cold cathode fluorescent lamp brightness;

controlling the variable oscillation circuit so that the primary ac input frequency approaches the resonance frequency of the piezoelectric transformer when the detected ac voltage of the secondary ac output is greater than a specific voltage;

controlling the variable oscillation circuit so that the primary ac input frequency recedes from the resonance frequency of the piezoelectric transformer when the detected ac voltage of the secondary ac output is less than the specific voltage; and

making the detected ac voltage of the secondary ac output and the specific voltage equal.

28. A cold cathode fluorescent lamp drive method according to claim 21, wherein the primary ac input comprises the pulse signals of a plurality of switching elements driven by pulse signals, and the primary ac input is applied to the primary electrodes; and

phase difference detection by the brightness control circuit detects a phase difference between pulse signals input to the switching elements, and the secondary ac output converted to a rectangular wave pulse signal by zero cross detection.